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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • National Institutes of Health • National Institute on Alcohol Abuse and Alcoholism

FEATURE

SHINING A LIGHT ON ALCOHOL BLACKOUTS

What does it mean when someone says they were “blackout drunk?” How does a blackout differ from “passing out” after drinking, and what are the possible dangerous effects of drinking enough to blackout?

Blackouts are periods of amnesia during which a person actively engages in behaviors like walking and talking but does not create memories for these events as they transpire. This results in missing periods of time in the person’s autobiographical record. Blacking out is quite different from passing out, which means either falling asleep from excessive drinking or literally drinking oneself unconscious.

All blackouts are not the same and are distinguished by the severity of the amnesia. The most common form of blackout involves spotty memories for events, with islands of memories separated by missing memories in between. This form often is referred to as a *fragmentary blackout*, a *grayout*, or a *brownout*. With this type of blackout, focusing on the islands of memories often helps cue recall for some, but not all, of the missing pieces. Full and complete amnesia often spanning hours or more is known as an *en bloc blackout*. With this severe form of blackout, trying to fill in the missing pieces typically is fruitless. The memories were never formed and so no amount of digging will uncover them. They simply don’t exist.

It seems that alcohol produces blackouts by shutting down circuits that involve the hippocampus, a brain area which plays a central role in consolidating

Blackout – Amnesia for places a person went or things they did while intoxicated; can involve spotty memory (fragmentary blackout, brownout, or grayout) or large missing chunks of time (en bloc blackout).

Blacking out vs. Passing out – Blacking out from alcohol implies that a person is awake and functioning but unable to create memories for events and actions. Passing out from alcohol implies a person is asleep or unconscious from drinking too much. The two states are quite different.

memories for what happens in our day-to-day lives. Information coming into the brain from the world around us is processed in various brain areas and then funneled to the hippocampus, which somehow weaves the information together into a running record of facts and events in our lives, a process called consolidation. By interfering with how these memory circuits work, alcohol creates a void in the record-keeping system.

During a blackout, the ability to remember things that happened before the blackout typically is spared. Because of this, even in the midst of a blackout,

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FEATURE

TREATMENT FOR PROBLEM DRINKING:
WHAT ARE THE OPTIONS?

Ask someone on the street how alcoholism is treated and you'll likely get one of two answers: a 28-day inpatient recovery program or Alcoholics Anonymous. Both of these responses are correct; however, they represent just a sample of what has grown to be a broad menu of options for people struggling with problem drinking.

Over the past 60 years, advances in the field have expanded the treatment options available to the estimated 18 million Americans with a diagnosable alcohol use disorder. Individuals can now choose to receive help with limited disruption to their home and professional lives. Addiction experts have refined behavioral treatments that deal with the thoughts and feelings which lead to problem drinking, and research scientists have developed medications that have been approved by the U.S. Food and

Drug Administration (FDA) specifically for treating alcohol use disorders.

Ultimately, someone trying to address an alcohol problem has more options than ever before, and although there is no one-size-fits-all solution, simply seeking treatment is a vital first step.

DOES TREATMENT WORK?

No matter how severe the problem may seem, almost all people with an alcohol use disorder can benefit from some form of treatment. Research shows that about one-third of people who are treated for alcohol problems have no further symptoms 1 year later. Many others substantially reduce their drinking and report fewer alcohol-related problems.

OPTIONS FOR TREATMENT

There are three broad types of treatment for alcohol problems:



- **Behavioral treatments** are aimed at changing drinking behavior through counseling. During treatment, individuals may work with a health professional to develop skills needed to stop or reduce drinking, build strong social support

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BY THE NUMBERS

PERCENTAGE OF DRINKERS RECEIVING TREATMENT

Having a drink is something that is enjoyed in many cultures throughout the world—alcohol is common in settings from religious services to backyard barbeques, and

many places in between. Nearly 87 percent of Americans report having tried alcohol at some point in their lifetime, and 56 percent have had a drink within the past month.¹

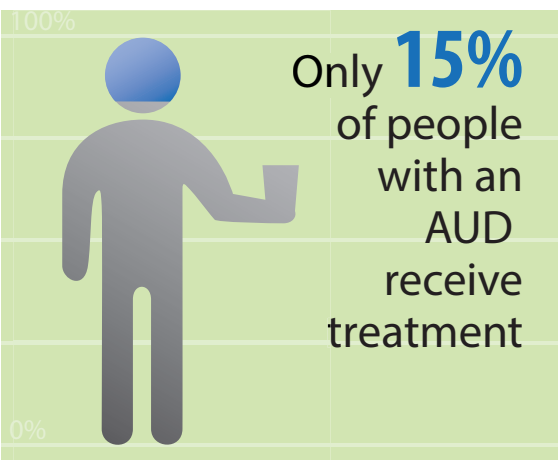
may choose to pursue alcohol treatment. Research shows, however, that of all the people with an alcohol use disorder, only about 15 percent ever receive treatment.^{4,5}

Most of those who drink alcohol do so at levels that pose little risk for problems. However, an estimated 18 million Americans have an alcohol use disorder—a medical term that includes both alcoholism and harmful drinking.^{2,3}

Alcohol problems can impact a person's life in many ways: economically, physically, and psychologically. When facing these kinds of problems, an individual

Why do so few people receive treatment? We know that the majority of those with alcohol dependence do not perceive a need for treatment.⁶ It's important that researchers and health care professionals recognize this disparity in perceived need in order to help those who would benefit from treatment. A recent study⁷ sheds some light on why individuals

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systems, set reachable goals, and cope with stressful situations that might cause relapse.

- **Medications**, three of which (naltrexone, acamprosate, and disulfiram) have been approved by the FDA for treating alcohol dependence, are non-habit forming and often are used in conjunction with behavioral treatment.
- **Mutual-support groups**, such as Alcoholics Anonymous and other 12-step programs, provide peer support for quitting or cutting back on drinking. These programs can add a valuable layer of support when combined with other forms of treatment.

FINDING HELP

Seeking treatment improves the chances of overcoming an alcohol problem. However, each year only about 15 percent of people with drinking problems receive help.

Starting with a primary care physician can be an important first step. A physician can evaluate whether a person's drinking pattern is risky, evaluate overall health, help craft a treatment plan, and assess if medications may be appropriate. For individuals with severe problems with alcohol, physicians also can provide a referral to a treatment specialist.

It is important to remember that no single treatment will benefit everyone. What may work well for one person may not be a good fit for someone else. There are many roads to getting better—what is important is finding the best fit.

To locate a treatment specialist for alcohol use disorders in your area, visit the Substance Abuse and Mental Health Services Administration (SAMHSA) Substance Abuse Treatment Locator (<http://findtreatment.samhsa.gov/>) or contact the American Society of Addiction Medicine (www.asam.org) or the American Academy of Addiction Psychiatrists (www.aap.org).

NEW NIAAA PUBLICATION— TREATMENT FOR ALCOHOL PROBLEMS: FINDING AND GETTING HELP

NIAAA soon will be releasing a publication for the public that describes the current range of options for treating alcohol use disorders. It is intended as a resource to help people understand what choices are available and what to consider when selecting among them. Look for it for more details on current treatment options and recent research advances.

For more information on alcohol use disorders and to assess your own drinking pattern, visit NIAAA's Rethinking Drinking Web site (RethinkingDrinking.niaaa.nih.gov)

NEWS FROM THE FIELD

SINGLE EPISODE OF BINGE DRINKING LINKED TO GUT LEAKAGE AND IMMUNE SYSTEM EFFECTS



A single episode of binge drinking can cause bacteria to leak from the gut and increase levels of bacterial toxins in the blood, according to an NIAAA-funded study that appears in the journal *PLoS ONE*. Increased levels of these bacterial toxins, called endotoxins, were shown to affect the immune system, with the body producing more immune cells involved in fever, inflammation, and tissue destruction.

“While the negative health effects of chronic drinking are well-documented, this is a key study that shows a single episode of binge drinking can cause damaging effects such as bacterial leakage from the gut into the bloodstream,” said NIAAA Director Dr. George Koob, Ph.D.

Binge drinking is defined by NIAAA as a pattern of drinking alcohol over two hours that brings blood alcohol concentration (BAC) to 0.08g/dL or above. For a typical adult, this pattern corresponds to consuming 5 or more drinks for men or 4 or more drinks for women, in about 2 hours. Some individuals will reach a 0.08 g/dL BAC sooner depending on body weight.

In this study, subjects were given enough alcohol to reach a 0.08 g/dL BAC within an hour. The researchers found that this episode of binge drinking resulted in a rapid increase in endotoxin levels in the blood and evidence of bacterial DNA, showing that bacteria had permeated the gut. Endotoxins are toxins contained in the cell wall of certain bacteria that are released when the cell is destroyed. Compared with men, women had higher blood alcohol levels and higher circulating endotoxin levels.

“We found that a single episode of binge drinking can elicit an immune response, potentially impacting the health of an otherwise healthy

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NEWS FROM THE FIELD

MUSCLE WEAKNESS SEEN IN ALCOHOLISM LINKED TO MITOCHONDRIAL REPAIR ISSUES



Muscle weakness from long-term alcoholism may stem from an inability of mitochondria, the powerhouses of cells, to self-repair, according to a recent study published online in the *Journal of Cell Biology*.

Gyorgy Hajnóczky, M.D., Ph.D., Director of Thomas Jefferson University's MitoCare Center in Philadelphia, led a team whose research in rats found evidence that chronic heavy alcohol use affects a gene involved in mitochondrial repair and muscle regeneration.

Mitochondria are cellular structures that generate most of the energy that cells need to function. Skeletal muscle constantly relies on mitochondria for power. Damaged mitochondria in many of the body's tissues can repair themselves through a process called mitochondrial fusion—joining with other mitochondria and exchanging material such as DNA.

The current study showed that mitochondria in skeletal muscle also can use fusion as a repair mechanism. Scientists had believed this self-repair process was unlikely in the packed fibers of skeletal muscle cells, as mitochondria have little opportunity to interact in the narrow space between the thread-like structures called myofilaments that make up muscle.

By tagging mitochondria in the muscle tissue of rats with different colors, the researchers were able to observe the mitochondrial fusion process in action. They also identified a key protein in the process, called mitofusin 1 (Mfn1),

and showed that chronic alcohol use interferes with the process.

In rats that were given an alcohol diet, Mfn1 levels decreased as much as 50 percent, whereas other fusion proteins were unchanged. This decrease in Mfn1 was coupled with a dramatic decrease in mitochondrial fusion. When Mfn1 returned to normal, mitochondrial fusion did as well.

“That alcohol can have a specific effect on this one gene involved in mitochondrial fusion suggests that other environmental factors also may alter specifically mitochondrial fusion and repair,” said Dr. Hajnóczky. He also suggested that identifying the proteins involved in mitochondrial fusion may aid in drug development for alcohol-related muscle weakness.

Source:

Eisner, V.; Lenaers, G.; and Hajnóczky, G.J. Mitochondrial fusion is frequent in skeletal muscle and supports excitation-contraction coupling. *Journal of Cell Biology* 205(2):179–195, 2014. PMID: 24751540

FEATURE: Alcohol Blackouts . . . Continued from page 1

a person can carry on conversations and even tell stories about events that happened years ago or earlier in the evening while they were intoxicated but not yet in the blackout. Outside observers typically are unaware that an individual is in a blackout. Depending on how much alcohol the person drank and how impaired other brain functions are, a person in the midst of a blackout could appear incredibly drunk—or not overly intoxicated at all.

Anything a person can do while they are drunk and not blacked out they can do while they are blacked out—they just won't remember it the next day. Depending on how impaired the brain regions involved in decisionmaking and impulse control are, the missing

events could range from mundane behaviors, like brushing teeth, to dangerous and traumatic events like driving a car, getting into a fight, or committing—or being the victim of—a sexual assault or other crime.

Blackouts are surprisingly common, particularly among younger drinkers. Across four waves of the Harvard College Alcohol Study, which spanned the 1990s, roughly 1 in 4 male and female students each year experienced a blackout—defined as not being able to remember places that they went or things they did while drinking. Smaller studies by researchers at Duke University report that roughly 1 in 10 male and female college students and recent high-school graduates

experienced at least 1 blackout in the 2 weeks before being surveyed.

Research suggests that there are several factors that can increase one's risk of blacking out, in particular drinking in ways that cause one's blood alcohol concentration (BAC) to rise quickly and reach a high level. The BAC rises quickly when lots of alcohol gets into the bloodstream at once. This could mean drinking on an empty stomach, doing shots, chugging alcoholic beverages, or all three. Being a female is also a risk factor for several reasons. Females are more likely to drink on an empty stomach than males, and they tend to drink beverages with higher concentrations of alcohol than beer,

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NEWS FROM THE FIELD

SMARTPHONE TECHNOLOGY HELPS PEOPLE CUT DOWN ON DRINKING



A smartphone-based application helped people in recovery from alcohol use disorders to cut down on drinking days, according to a recent clinical trial conducted by researchers at the University of Wisconsin–Madison.

The study enrolled 349 adults leaving residential alcohol treatment centers. The volunteers took part in a postrehabilitation support program in which they were randomly assigned into two groups. The control group received standard treatment, whereas another group received standard treatment plus a new smartphone with the intervention app, called A-CHES—short for Addiction-Comprehensive Health Enhancement Support System.

A-CHES offers a multifaceted toolset for recovery. Using GPS technology, the app can alert owners when they approach high-risk areas such as bars. The “panic button” can quickly connect patients with counselors and support contacts. A-CHES also can link to meetings, recovery information, and tips to ease stress (view the tools at <http://chess.wisc.edu/achess-archive/>).

The study team followed both groups for 1 year, with surveys conducted at 4, 8, and 12 months. One of the outcome measures focused on “risky drinking days,” when a patient’s drinking in a 2-hour period exceeded 4 standard drinks for men and 3 for women.

The findings revealed that participants in the A-CHES group reported less than a day and a half, on average, of risky drinking in the past month. That proved significantly lower than the

control group, who reported almost 3 days of risky drinking per month.

In addition, more than half of the A-CHES group reported total abstinence from drinking within the past month, compared with only 40 percent of the control group.

The researchers also underscored that participation rates for individuals using A-CHES were higher than rates typically seen in aftercare programs for alcohol use disorders.

The results are promising for the continued study of the effectiveness of eHealth intervention tools to help people in alcoholism recovery.

Source:

Gustafson, D.H.; McTavish, F.M.; Chin, M.Y.; et al. A smartphone application to support recovery from alcoholism: A randomized clinical trial. *JAMA: Journal of the American Medical Association. Psychiatry* 71(5):566–572, 2014. PMID: 24671165

NEWS FROM THE FIELD

MINIMUM LEGAL DRINKING AGE SHOWN TO SAVE LIVES

Research affirms the effectiveness of the age 21 minimum drinking age.

Although often disobeyed and not always enforced, the age 21 minimum legal drinking age (MLDA) saves lives and prevents a range of other harms, according to a recent review published in the *Journal of Studies on Alcohol and Drugs*. Authors William DeJong, Ph.D., and Jason Blanchette, M.P.H., of the Boston University School of Public Health and the Boston University School of Medicine, respectively, reviewed studies published since 2006 on the effects of the age 21 MLDA.

They found that the age 21 MLDA is associated with a 5 to 9 percent decrease in traffic fatalities for drivers between the ages of 18 and 21.

Furthermore, heavy-drinking rates for college students (defined by the authors as having 5 or more drinks in a row at least once in the past 2 weeks) have steadily decreased since 1988, by which time all 50 States had adopted the age 21 MLDA.

The authors note that in 2006, an organization called Choose Responsibility, led by a former college president, began a campaign to lower the MLDA to age 18. According to the campaign—known as the Amethyst Initiative—the solution to underage drinking was to lower the drinking age and teach college students the appropriate use of alcohol. Authors DeJong and Blanchette suggest that given the research evidence, college and university leaders should

accept that the age 21 law saves lives and focus their efforts on “workable policies, stricter enforcement, and other evidence-based prevention efforts that have been demonstrated to reduce underage drinking and alcohol-related problems on campus.”

Source:

DeJong, W., and Blanchette, J. Case closed: Research evidence on the positive public health impact of the age 21 minimum legal drinking age in the United States. *Journal of Studies of Alcohol and Drugs Supplement* 17:108–115, 2014. PMID: 24565317



A CLOSER LOOK

“HOLDING YOUR LIQUOR” HOLDS A WARNING

To feel relatively unaffected by a given amount of alcohol—the ability to “hold your liquor”—is a source of pride for some people. For them, it takes quite a few drinks to get a buzz—and they show little effect even when others get groggy despite drinking at the same pace. Often people are unaware that this “low level of response” to alcohol doesn’t offer protection from alcohol problems, but instead, it’s a reason for caution. These individuals tend to drink more, socialize with people who drink a lot, and develop a tolerance to alcohol. Many studies confirm that they have an increased risk for alcohol use disorders (AUDs). The good news is, if these individuals become aware of the risk and drink only in moderation, they can avoid harm.

A low level of response to alcohol at any given blood alcohol concentration (BAC) seems to be an innate, genetically influenced trait that reflects a biological variation in how the brain responds to alcohol. It shows up early, in young people who have just begun to drink, long before alcohol-related problems start. It may be different from a chronic tolerance to alcohol, which develops over time as the brain and body adapt to ongoing drinking.

Investigators have used two main routes to explore individual responses to alcohol: measuring reactions at

different BACs in laboratory settings and using questionnaires about the number of drinks it takes to feel a range of effects. The lab research has helped to validate the questionnaires while clarifying a biological basis for different alcohol sensitivities, including variations in central nervous system hormone levels; brain-wave patterns; and, most recently, functional brain images. After identifying people with different levels of response to alcohol, researchers followed up over several years to see who had and had not developed alcohol-related problems.

More than 30 years of research confirmed that people with a low level of response to alcohol—particularly its sedating effects such as slurred speech, unsteadiness, and passing out—have an increased risk for escalating alcohol use and AUDs later in life.

More than 30 years of research confirmed that people with a low level of response to alcohol—particularly its sedating effects such as slurred speech, unsteadiness, and passing out—have an increased risk for escalating alcohol use and AUDs later in life.



Importantly, alcohol sensitivity is an early warning signal that can shape prevention approaches. A pilot program for college students with a low level of response to alcohol has shown promise in reducing drinking in this high-risk group. In addition to making students aware of their increased risk, the program taught them ways of countering unhelpful alcohol-related peer influences and managing their expectations, as well as coping strategies. The researchers hope this pilot encourages more efforts to test this and other interventions that target traits which predispose people to alcohol problems.

Sources:

Schuckit, M.A.; Kalmijn, J.A.; Smith, T.L.; et al. Structuring a college alcohol prevention program on the low level of response to alcohol model: A pilot study. *Alcoholism: Clinical and Experimental Research* 36(7):1244–1252. PMID: 22309202

Schuckit, M.A.; Tapert, S.; Matthews, S.C.; et al. fMRI differences between subjects with low and high responses to alcohol during a stop signal task. *Alcoholism: Clinical and Experimental Research* 36(1):130–140, 2012. PMID: 22003983

5 QUESTIONS WITH . . .

AARON WHITE, PH.D.

Program Director for Underage and College Drinking Prevention Research at NIAAA



1 As science teaches us more about alcohol and the adolescent brain, do you think parents fully appreciate the short- and long-term consequences of underage drinking?

I think parents are slowly gaining a better awareness of the risks. As more and better information about the influence of alcohol on adolescent development becomes available, I do believe parents will increasingly appreciate the implications. Hopefully, greater appreciation for the risks will translate into more conversations between parents and teens about alcohol and the importance of delaying the start of use.

2 So what should parents be doing or saying to their high-school graduates?

For many young people, there is a tendency to increase drinking levels during the transition from high school to college, the military, or the workforce. Drinking excessively carries risks—one of those risks is blacking out, or being unable to recall key details of events during an interval of time while intoxicated. We know that around 1 in 10 recent high-school graduates who drinks experiences a

blackout in a 2-week period during the summer after graduation; so they are common. It is important for parents to talk with teens about blackouts and other consequences of excessive drinking, including risky decisionmaking—and even death—in order to help teens avoid these consequences.

3 Are you excited about the research progress that has been made in recent years?

Yes! Between the 1940s, when research on alcohol blackouts began, and the end of the 20th century, relatively few studies on blackouts were published, and most involved subjects who were middle-aged male Caucasian alcoholics. Over the last decade, there has been an increase in research on blackouts, revealing that blackouts are relatively common. These recent studies also suggest that there are differences in how strongly alcohol affects the memory circuits of those who blackout and those who don't. For instance, a few studies have shown that people who blackout also are more sensitive to the effects of smaller doses of alcohol on memory, suggesting an inherent vulnerability of the memory circuits to alcohol. In addition, recent studies suggest that circuits regulating impulse control in adolescents who haven't yet started drinking may hold clues to predicting whether they will have blackouts once they do start drinking. This work further suggests that there are inherent vulnerabilities to alcohol blackouts about which we need to learn more.

4 What are some important unanswered questions about blackouts?

There still are quite a few unknowns about blackouts. For instance, at a national level, how common are

blackouts among people in various age, racial, and ethnic groups? Are rates going up or down? How do gender differences in beverage choices and drinking styles (for example, drinking on an empty stomach, choosing beer versus liquor, etc.) and physiological differences affect the likelihood of experiencing blackouts? Could a family history of alcoholism and/or family history of blackouts be predictive of blackouts? How common are sexual encounters during blackouts, and how do the participants learn about and view such encounters? How often do sexual assaults and other crimes occur in which the perpetrator, victim, or both, are in a state of blackout? What role do other drugs play in alcohol blackouts? Is it possible to know if someone is in the midst of an alcohol blackout? If so, how should people respond if they believe someone is in a blackout? Given overlap in the general mechanisms for how alcohol and some prescription sleep medications and anxiolytics affect memory circuits, does sensitivity to alcohol blackouts also predict sensitivity to amnesia from these medications or vice versa? And what if alcohol is combined with these meds?

5 If you didn't pursue a career in research, what might you have done?

As an undergraduate, my objective was to go to medical school, but I took a course in biological psychology my junior year and I decided on the very first day that I wanted to become a biological psychologist, which I did! Perhaps if I hadn't taken that course I would have gone to medical school but who knows? I also worked in hotel management as an undergraduate, so perhaps I'd be running a hotel somewhere instead.

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such as mixed drinks, shots, and wine. From a biological standpoint, they reach higher BACs than males after each drink as a result of differences in the amount of water in the body. In all cases, the best predictor that a drinker will black out is that they have blacked out before. Some people seem to be very susceptible to blackouts, whereas others are relatively resistant

to the serious effects of alcohol on memory. Research with twins suggests that if one twin experiences blackouts the other is likely to experience them too, so it seems there is a genetic component to sensitivity to blackouts.

Blackouts aren't necessarily a sign of a problem with alcohol, but they are always a reason for concern and should

prompt a person to consider their relationship with alcohol.

For more information, see NIAAA's fact sheet, "Alcohol Overdose: The Dangers of Drinking Too Much." Available at: <http://pubs.niaaa.nih.gov/publications/AlcoholOverdoseFactsheet/Overdosefact.htm>.

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may not choose to seek treatment. Researchers found that the biggest obstacle to seeking treatment is pessimism about treatment's effectiveness.

To help promote awareness of alcohol disorder symptoms and treatment options, NIAAA has created numerous products for health care professionals and the general public, including *Helping Patients Who Drink Too Much: A Clinician's Guide*, and *Rethinking Drinking: Alcohol and Your Health*.

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individual," said senior author Dr. Gyongyi Szabo, M.D., Ph.D., of the University of Massachusetts Medical School. "Our observations suggest that an episode of binge drinking is more dangerous than previously thought."

Source:

Bala, S.; Marcos, M.; Gattu, A.; et al. Acute binge drinking increases serum endotoxin and bacterial DNA levels in healthy individuals. *PLoS ONE* 9(5):e96864, 2014. PMID: 24828436

ABOUT US

NIAAA Spectrum is NIAAA's first-ever Webzine. With engaging feature articles, short news updates, and colorful graphics, *NIAAA Spectrum* offers accessible and relevant information on NIAAA and the alcohol research field for a wide range of audiences.

Each issue includes feature-length stories, new research findings from the field, image and data analyses, and an interview with an NIAAA staff member or alcohol researcher. *NIAAA Spectrum* is published three times a year.

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